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Can lactate clearance replace APACHE II in sepsis prognostication? Evidence from a prospective clinical study

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Abstract

Background: Early identification of high-risk sepsis patients is essential for optimizing treatment and improving survival. Lactate clearance and APACHE II score are widely recognized prognostic tools, but comparative data in Indian clinical settings remain limited.

Methods: This prospective study was conducted at Pushpagiri Medical College Hospital, Kerala, from January to September 2025, enrolling adults diagnosed with sepsis or septic shock. Admission lactate and six-hour lactate levels were recorded to calculate lactate clearance. APACHE II scores were obtained within 24 hours of ICU admission. Patients were followed for ICU and 28-day mortality. Statistical analyses included ROC curves and logistic regression.

Results: Among 120 patients, overall mortality was 35%. Non-survivors had significantly higher admission lactate, lower lactate clearance, and higher APACHE II scores. Lactate clearance showed strong predictive value (AUC 0.89), while APACHE II demonstrated slightly superior discrimination (AUC 0.91). Both parameters independently predicted mortality.

Conclusion: Lactate clearance and APACHE II score are robust prognostic indicators in sepsis. Early lactate clearance provides dynamic assessment of therapeutic response, whereas APACHE II reflects overall physiological severity. Using both tools together enhances early risk stratification and supports clinical decision-making in sepsis management.

Keywords: Sepsis; Lactate clearance; APACHE II; Mortality prediction; Critical care

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Introduction

Sepsis remains a leading cause of ICU admission and death worldwide, with mortality often exceeding 25–30% despite advances in antimicrobial therapy and organ support [1]. Early risk stratification is crucial to guide resuscitation intensity, allocate critical care resources, and inform family counselling. Serum lactate, a marker of tissue hypoperfusion and impaired microcirculation, is strongly associated with adverse outcomes, and recent Surviving Sepsis Campaign guidelines recommend using lactate trends to guide resuscitation in patients with sepsis and septic shock [1]. Dynamic assessment of lactate clearance, rather than single measurements, has emerged as a promising bedside biomarker that reflects both severity of shock and response to therapy, and has been shown to predict sepsis-associated acute kidney injury and mortality [2-4]. However, its performance relative to validated physiological scores in routine ICU practice remains incompletely defined [2, 3].

The Acute Physiology and Chronic Health Evaluation II (APACHE II) score is one of the most widely used ICU severity scores and has demonstrated good to excellent discrimination for mortality in septic cohorts [2,4]. Emerging data suggest that combining lactate-derived indices with APACHE II may further improve prognostic accuracy, yet head-to-head comparisons between early lactate clearance and APACHE II for mortality prediction in adult sepsis are limited, especially in resource-constrained settings [5]. Therefore, the present study aims to compare lactate clearance and APACHE II score in predicting ICU and 28-day mortality among adult patients with sepsis or septic shock.

Methods:

This prospective observational study was conducted in the Department of General Medicine and Intensive Care Unit at Pushpagiri Medical College Hospital, Tiruvalla, Kerala, from January 2025 to September 2025. Adult patients aged ≥18 years who fulfilled the Sepsis-3 criteria for sepsis or septic shock at the time of ICU admission were consecutively enrolled. Patients with conditions known to alter lactate physiology such as advanced liver failure, metformin-associated lactic acidosis, hematological malignancies, or recent seizures were excluded. After obtaining informed consent from the patient or legally authorized representative, baseline demographic details, comorbidities, clinical presentation, SOFA score, and APACHE II score were recorded within the first 24 hours of ICU

admission. Arterial blood samples for serum lactate estimation were drawn at admission (0 hours) and repeated at 6 hours as per institutional sepsis management protocol. Lactate clearance was determined by measuring lactate at admission and again after six hours, then assessing how much the level reduced over time to indicate improvement in tissue perfusion and response to treatment.

Patients were followed until ICU discharge or death, and subsequently up to 28 days via electronic medical records or telephonic follow-up to determine 28-day mortality. All patients received standard sepsis management, including fluid resuscitation, early antibiotics, vasopressor support, and organ support according to Surviving Sepsis Campaign guidelines. All data were entered into a structured case record form and later transferred to Microsoft Excel for cleaning and coding. Statistical analysis was performed using SPSS version 21.0. Continuous variables such as lactate levels, lactate clearance, and APACHE II scores were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR) depending on distribution. Categorical variables were summarized as frequencies and percentages. Group comparisons between survivors and non-survivors were carried out using the Student's t-test or Mann–Whitney U test for continuous variables and the Chi-square test for categorical variables. The prognostic performance of lactate clearance and APACHE II score in predicting ICU and 28-day mortality was assessed using receiver operating characteristic (ROC) curve analysis, and the area under the curve (AUC) with 95% confidence interval (CI) was calculated. Optimal cut-off values were determined using Youden's Index. Multivariable logistic regression was performed to evaluate independent predictors of mortality, adjusting for age, comorbidities, baseline lactate, and organ dysfunction scores. A p-value <0.05 was considered statistically significant. Data confidentiality and ethical compliance were maintained throughout the study in accordance with institutional ethical committee approval.

Results:

A total of 120 patients with sepsis or septic shock were enrolled between January and September 2025. The overall mortality rate was 35%. Baseline demographic and clinical characteristics differed significantly between survivors and non-survivors. Non-survivors were older and more frequently presented with septic shock, indicating higher initial illness severity (Table 1). Initial lactate values were markedly higher among non-survivors, and their lactate levels remained persistently elevated at six hours, resulting in substantially lower lactate clearance compared with survivors (Table 2). Lactate clearance showed a strong association with survival, with survivors demonstrating more than threefold improvement in clearance, reflecting better hemodynamic response. APACHE II scores were significantly higher in non-survivors, reaffirming its established prognostic utility in critically ill septic patients (Table 3). Non-survivors also had higher SOFA scores and required vasopressor support more frequently, indicating severe organ dysfunction. Receiver operating characteristic analysis revealed that both lactate clearance and APACHE II score were strong predictors of mortality. Lactate clearance demonstrated an AUC of 0.89, whereas APACHE II showed a slightly higher AUC of 0.91, indicating excellent discriminative power for both indicators (Table 4). Optimal cut-off thresholds were defined for each parameter to achieve high sensitivity and specificity. Overall, the findings demonstrated that low lactate clearance within the first six hours and elevated APACHE II scores at admission were significantly associated with ICU and 28-day mortality. Both parameters served as robust prognostic tools, with APACHE II slightly outperforming lactate clearance in predicting adverse outcomes.

Discussion:

In this prospective study, we compared the prognostic performance of lactate clearance and APACHE II score in predicting mortality among adults with sepsis and septic shock. The findings demonstrated that both indicators were strongly associated with ICU and 28-day mortality, reaffirming their established roles in sepsis risk stratification. Elevated admission lactate levels and persistently raised lactate after six hours were significant predictors of poor prognosis, consistent with previous research showing lactate as a surrogate marker of tissue hypoxia and impaired perfusion [1]. Early lactate clearance emerged as a powerful indicator of treatment response, with survivors showing substantial reduction in lactate during the early resuscitation period. These results align with evidence that dynamic changes in lactate may offer superior prognostic accuracy over static lactate measurements [2]. The strong association between low lactate clearance and increased mortality highlights the clinical value of incorporating serial lactate monitoring into routine sepsis management protocols [6].

The study also confirmed that APACHE II score retained its robustness as a reliable mortality predictor in sepsis. Non-survivors had significantly higher APACHE II scores, which reflected greater physiological derangement at the time of ICU admission. This finding mirrors global observations where APACHE II consistently demonstrates high discriminative ability in diverse ICU populations [7]. Although APACHE II is a validated and widely used severity scoring system, its utility in resource-limited or high-burden environments has sometimes been questioned due to the complexity of data

collection. Nonetheless, our study showed that APACHE II maintained excellent predictive performance, with an area under the ROC curve comparable to contemporary literature. Importantly, while lactate clearance reflects early hemodynamic improvement, APACHE II captures multi-system physiological disruption, making both markers complementary rather than competitive [8]. Their combined interpretation can assist clinicians in identifying patients requiring aggressive intervention or escalation of care.

Furthermore, the higher prevalence of septic shock, elevated SOFA scores, and higher vasopressor requirement among non-survivors in our study underscores the interplay between circulatory failure and multi-organ dysfunction in determining sepsis outcomes. The strong association between reduced lactate clearance and greater organ dysfunction supports earlier findings that persistent hyperlactatemia is an early warning signal of impending organ failure [9]. Studies have also shown that lactate kinetics correlate strongly with microcirculatory dysfunction and mitochondrial impairment, mechanisms increasingly recognized as central to sepsis pathobiology [10]. Our study supports the Surviving Sepsis Campaign guidelines recommending the use of lactate levels to guide resuscitation, especially within the first hours of management. The markedly lower lactate clearance observed among non-survivors suggests inadequate reversal of tissue hypoperfusion despite standard therapy, emphasizing the importance of individualized resuscitation strategies. Improving lactate clearance may therefore serve not only as a prognostic marker but also as a therapeutic target.

The comparative analysis showed that APACHE II slightly outperformed lactate clearance in predicting mortality based on AUC, although the difference was clinically modest. Similar findings from international studies suggest that incorporating both parameters may enhance early risk prediction and treatment personalization [3, 11]. Given that lactate clearance provides dynamic information and APACHE II provides a systemic physiological snapshot, combining these tools may enhance prognostic accuracy, especially within the first six hours of sepsis resuscitation. One key strength of this study is its prospective design and uniform measurement protocol, which minimized temporal variability in lactate sampling. However, limitations include the single-center setting, relatively small sample size, and potential unmeasured confounders such as variability in sepsis source control timing and antibiotic initiation. Future research should explore integrating lactate kinetics with machine-learning-based risk models to offer real-time predictive analytics for sepsis outcomes. Overall, our findings reinforce that both lactate clearance and APACHE II provide robust and clinically actionable prognostic information and should be incorporated into routine ICU decision-making for sepsis management.

Conclusion: This prospective study demonstrated that both lactate clearance and APACHE II score are strong and clinically meaningful predictors of mortality in adults with sepsis and septic shock. Low lactate clearance during the first six hours of resuscitation and high APACHE II scores at admission were significantly associated with ICU and 28-day mortality. While APACHE II showed slightly superior discriminative performance, lactate clearance provided valuable dynamic insight into treatment response. The combined use of these parameters can enhance early risk stratification and guide timely therapeutic interventions. Incorporating both metrics into routine sepsis management may improve prognostication and optimize critical care outcomes.

References

1. Evans L, Rhodes A, Alhazzani W, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. Intensive Care Med. 2021; 47(11):1181 – 247.
2. Yezhou Shen, Jiaoyang Yu, Fei Zhou, et al. The predictive performance of the lactate clearance rate combined with the APACHE II score in the prediction of sepsis-associated acute kidney injury in 7 days. Transl Androl Urol 2022; 11(4):543 – 53.
3. Taye NM, Priyadarshani P, Agrawal R. Comparison of Lactate Kinetics and Lactate-albumin Ratio with Apache II Score in Prediction of In-hospital Mortality in Sepsis Patients. Indian J Crit Care Med. 2024; 28(Suppl 1): S324 – 5.
4. Ali AHD, Harun SN, Othman N, Ibrahim B, Abdulbagi OE, Abdullah I, Ariffin IA. Discriminatory Performance of APACHE II Score and the Prediction of Mortality within the ICU in Patients with Sepsis Admitted to the ICU. Mater Sociomed. 2025; 37(2):153 – 8.
5. Atiharsh Mohan Agarwal, Amrita Gupta, Sunit Kumar, et al. Comparison Of the Prognostic Significance Between Central Venous to Arterial Carbon Dioxide Difference (PCO2-GAP), Lactate Clearence and APACHE II Score in Critically Ill Patient In ICU. Eur J Car Med. 2024; 14: 282 – 8,
6. Lee SG, Song J, et al. Prognostic value of lactate levels and lactate clearance in sepsis and septic shock with initial hyperlactatemia: A retrospective cohort study according to the Sepsis-3 definitions. Medicine (Baltimore). 2021; 100(7): e24835.
7. Mumtaz H, Ejaz MK, Tayyab M, et al. APACHE scoring as an indicator of mortality

rate in ICU patients: a cohort study. Ann Med Surg (Lond). 2023; 85(3): 416 – 21.
8. Deniz M, Ozgun P, Ozdemir E. Relationships between RDW, NLR, CAR, and APACHE II scores in the context of predicting the prognosis and mortality in ICU patients. Eur Rev Med Pharmacol Sci. 2022; 26(12): 4258 – 67.
9. Chaudhari M, Agarwal N. Study of Significance of Serum Lactate Kinetics in Sepsis as Mortality Predictor. Indian J Crit Care Med. 2022; 26(5): 591 – 5.
10. Puskarich MA. The Challenge and the Promise of Studying Mitochondrial Dysfunction in Humans with Sepsis. Ann Am Thorac Soc. 2015; 12(11): 1595 – 6.
11. Cirik MO, Doganay GE, Doganci M, et al. Comparison of Intensive Care Scoring Systems in Predicting Overall Mortality of Sepsis. Diagnostics. 2025; 15(13):1660.

Table 1: Baseline characteristics of the study population

Variable	Survivors (n = 78)	Non-survivors (n = 42)	p-value
Mean age (years)	56 ± 14	64 ± 13	0.01*
Male sex (%)	48 (61.5%)	28 (66.7%)	0.58
Diabetes mellitus (%)	34 (43.6%)	24 (57.1%)	0.16
Septic shock (%)	22 (28.2%)	26 (61.9%)	<0.001*

Table 2: Lactate levels and lactate clearance among the study members

Parameter	Survivors	Non-survivors	p-value
Admission lactate (mmol/L)	3.1 ± 1.2	4.8 ± 1.6	<0.001*
6-hour lactate (mmol/L)	1.9 ± 0.8	4.1 ± 1.4	<0.001*
Lactate clearance (%)	38.4 ± 12.7	10.2 ± 9.4	<0.001*

Table 3: APACHE II scores and severity indicators among the study members

Variable	Survivors	Non-survivors	p-value
APACHE II score	18.6 ± 5.4	28.3 ± 6.2	<0.001*
SOFA score	6.8 ± 2.1	10.2 ± 3.0	<0.001*
Vasopressor requirement (%)	34 (43.6%)	38 (90.5%)	<0.001*

Table 4: Prognostic accuracy of lactate clearance vs APACHE II among the study members

Parameter	AUC (95% CI)	Optimal Cut-off	Sensitivity	Specificity
Lactate clearance	0.89 (0.82–0.95)	20%	86%	81%
APACHE II score	0.91 (0.85–0.96)	24	88%	84%